

United States Environmental Protection Agency Washington, DC 20460				Work Assignment Number: <b>1-28</b> <input checked="" type="radio"/> Original <input type="radio"/> Amendment				
<b>Work Assignment</b>								
Contract Number: EP-C-09-027		Contract Period Base: 04/01/2010 - 03/31/2011 Option Period No. 1		SF Site Name:				
Title of Work Assignment: Mercury Speciation and Destruction of Organic HAPs in Coal-Fired Boilers Selective Catalytic Reduction Process								
Suggested Source: Arcadis				Specify Section & Paragraph of Contract SOW:				
Purpose: <input checked="" type="radio"/> Work Assignment Initiation      Work Assignment Close-Out <input type="radio"/> Work Assignment Amendment      Incremental Funding <input type="radio"/> Work Plan Approval				Period of Performance From: 04/01/2010 To: 03/31/2011				
Comments: New package This is a continuation of Arcadis WA 0-28 on this subject				QA Category (check one) <input type="radio"/> I Enforcement <input type="radio"/> II Standard Setting <input type="radio"/> III Technology Development <input checked="" type="radio"/> IV Proof of Concept <input type="radio"/> N/A				
Note: To report additional accounting and appropriations data use EPA Form 1900-69A.								
SFO 22 Superfund (Max 2)		Accounting and Appropriations Data						
		Non-Superfund						
DCN (Max 6)	Budget/FYs (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount	Sites/Project (Max 8)	Cost Org/Code (Max 7)
1								
2								
3								
4								
5								
Authorized Work Assignment Ceiling								
Contract Period:			Cost/Fee			LOE		
Previously Approved			New					
This Action								
Total								
Work Plan / Cost Estimate Approvals								
Contractor WP Dated:			Cost/Fee:			LOE:		
Cumulative Approved:			Cost/Fee:			LOE:		
Work Assignment Manager Name Chun-Wai Lee <i>Chun Wai Lee</i> 3/3/2010 (Signature) (Date)				Branch / Mail Code APTB; NHSRC / E305-01; E343-06				
				Phone Number (919) 541-7663; (919) 541-4531				
				Fax Number				
Branch Chief Name <i>for</i> Ravi Srivastava, Chief, APTB; <i>Diane L Pierce</i> 3/10/10 (Signature) (Date)				Branch/Mail Code APTB; NHSRC / E305-01; E343-06				
				Phone Number ;				
				Fax Number				
Project Officer Name Diane Pierce <i>Diane L Pierce</i> 3/10/10 (Signature) (Date)				Branch/Mail Code /				
				Phone Number 919-541-2708				
				Fax Number				
Contracting Official Name Renita Tyus, CO <i>Renita Tyus</i> 3/11/10 (Signature) (Date)				Branch/Mail Code CPOD				
				Phone Number (513) 487-2094				
				Fax Number (513) 487-2109				
Contractor Acknowledgement of Receipt and Approval of Workplan (Signature and Title)						Date		

Work shall not begin on this work assignment until 04/01/10.

## **Statement of Work for Work Assignment WA 1-28**

### **Mercury Speciation and Destruction of Organic HAPs in Coal-Fired Boilers Selective Catalytic Reduction Process**

#### **I. BACKGROUND**

The objective of this project is to evaluate the co-benefits of selective catalytic reduction (SCR) on oxidation of mercury and destruction of organic hazardous air pollutants (HAPs). The very limited European field data available suggest significant reduction of organic compound emissions across the SCR system used for reducing emissions of nitrogen oxides (NO<sub>x</sub>) from coal-fired utility boilers. EPA/OAQPS is currently evaluating the emissions of HAPs emissions which include organic HAPs as well as other toxic heavy metals to replace its mercury emissions rule making for coal-fired utility boilers. A large number of U.S. utility boilers are equipped with SCR for NO<sub>x</sub> control. Previous studies conducted by EPA and others indicated that SCR has a high potential to convert elemental mercury into the water soluble oxidized forms which are removed subsequently by the downstream wet scrubber used for controlling SO<sub>2</sub> emissions. The V<sub>2</sub>O<sub>5</sub>•WO<sub>3</sub>/TiO<sub>2</sub> based SCR catalyst may also promote the catalytic oxidation of organic compounds to reduce organic HAPs emissions. Initial test results obtained from FY09 (WA 0-29) indicated that significant destruction of benzene, a typical organic HAP, occurred through oxidation reactions under SCR NO<sub>x</sub> reduction conditions. Significant oxidation of mercury was also observed under such conditions. The focus of this work assignment is to continue the investigation of the effect of SCR on destruction of organic HAPs to support OAQPS' efforts on evaluating effective technical approaches for reducing organic HAPs emissions from coal-fired utility boilers.

#### **II. WORK REQUIREMENTS**

The contractor shall use the APTB's bench-scale SCR reactor (located at E-363) to investigate the destruction of organic HAPs under SCR NO<sub>x</sub> control conditions. Experiments shall be performed by the contractor to investigate destruction of HAPs across the SCR catalyst samples provided by the WAM in a particulate-free, simulated flue gas comprised of appropriate concentrations of Hg<sup>0</sup>, O<sub>2</sub>, H<sub>2</sub>O, CO<sub>2</sub>, NO<sub>x</sub>, HCl, and SO<sub>2</sub>. The flue gas is doped with trace levels of benzene and other potential organic HAPs such as polycyclic aromatic hydrocarbons (PAHs) which could be existed in coal combustion flue gas. PAHs can be generated by running the burner of the SCR reactor system under fuel-rich conditions. The experimental conditions shall be chosen to represent those experienced in typical utility boilers firing both Eastern bituminous coals and Western subbituminous coals. The experimental parameters of interest in this study are HCl, NO<sub>x</sub>, NH<sub>3</sub>, benzene and PAHs in the flue gas, as well as temperature and space velocity of the SCR catalyst. A parametric study is designed to gain a practical understanding of the effects of these variables on the heterogeneous destruction of organic HAPs by the SCR catalyst samples.

#### **III. SCOPE OF WORK**

The contractor shall conduct parametric tests at two temperatures (350 and 400 °C), two flue gas HCl concentrations (1 and 10 ppm), two flue gas SO<sub>2</sub> concentrations (200 and 1,000

ppm), two NO<sub>x</sub> concentrations (200 and 400 ppm), two concentrations (20 and 60 ppm) for benzene and PAHs, and two catalyst space velocities (different lengths of catalysts). The concentrations for PAHs will be determined later by the WAM after an ongoing in-house project for evaluating HAPs emissions from coal combustion (WA 0-50) is completed. The pilot-scale HAPs evaluation project will provide useful information on emissions of organic HAPs from coal combustion. The bench-scale SCR reactor is equipped with an on-line total hydrocarbon (THC) for measuring the benzene concentrations near the inlet and outlet of the SCR catalyst. The PAHs concentrations at the inlet and outlet of the catalyst will be measured continuously by a PAH analyzer made by EcoChem. Each individual bench-scale test is anticipated to reach its steady-state NO<sub>x</sub> reduction within 2 hours of start-up. After reaching the steady state, the extents of destruction of organic HAPs by the SCR catalyst shall be measured at a location downstream of the SCR catalyst.

#### **IV. REPORT OF WORK:**

The contractor shall prepare a work plan and budget within 15 days of WA effective date. The contractor shall prepare and submit monthly reports in accordance with the terms and conditions of the contract.

The contractor shall maintain at least weekly communications with the WAM. Additionally the contractor shall inform the PO and the WAM in writing when 75% of the total funds and/or hours contained in the work plan have been expended.

The contractor shall prepare, as requested by WAM, data summary, project progress reports, briefing materials, presentation for technical meetings/conferences, and paper submitting to peer reviewed journals. The contractor shall coordinate with the WAM to ensure compliance with NRMRL/APPCD policies and guidelines concerning review and approval of technical papers and reports. Technical papers and presentations will be co-authored with EPA researchers. . The contractor shall be required to attend an important technical conference such as the Power Plant Air Pollutant Control “MEGA” Symposium to be held in Baltimore later this year for collecting information and acquiring knowledge which are useful for conducting the research specified in this WA. The contractor’s travel shall be approved in writing by the WAM/PO in advance of the conference.

#### **V. QUALITY ASSURANCE/QUALITY CONTROL**

The contractor shall revise and update the QAPP for “Mercury Speciation and Hydrocarbon Destruction Across Selective Catalytic Reduction Process in Coal-fired Boilers” that was approved on 12/23/2009, for incorporating the measurements of organic HAPs including PAHs into the QAPP. Any work involving environmental data shall not commence until the QAPP has received official approval from the EPA QA staff.

## **ATTACHMENT #1 TO THE STATEMENT OF WORK (SOW) FOR MEASUREMENT PROJECTS**

### **NRMRL Quality Assurance (QA) Requirements**

In accordance with EPA Order 5360.1 A2, conformance to ANSI/ASQC E4 must be demonstrated by submitting the quality documentation specified herein. All quality documentation shall be submitted to the Government for review. The Government will review and return the quality documentation, with comments, and indicate approval or disapproval. If the quality documentation is not approved, it must be revised to address all comments and shall be resubmitted to the Government for approval. Work involving environmental data collection, generation, use, or reporting shall not commence until the Government has approved the quality documentation. The quality documentation shall be submitted to the Government at least thirty (30) days prior to the beginning of any environmental data gathering or generation activity in order to allow sufficient time for review and revisions to be completed. After the Government has approved the quality documentation, the Contractor shall also implement it as written and approved by the Government. Any EPA-funded project/program may be subject to a QA audit.

#### **TO BE SUBMITTED PRE-AWARD (mark all that apply):**

☐ **NRMRL's Quality System Specifications:**

- (1) a description of the organization's Quality System (QS) and information regarding how this QS is documented, communicated and implemented;
- (2) an organizational chart showing the position of the QA function;
- (3) delineation of the authority and responsibilities of the QA function;
- (4) the background and experience of the QA personnel who will be assigned to the project; and
- (5) the organization's general approach for accomplishing the QA specifications in the SOW.

- ☐ **Quality Management Plan:** prepared in accordance with R-2 - EPA Requirements for Quality Management Plans (EPA/240/B-01/002) March, 2001,  
<http://www.epa.gov/quality/qs-docs/r2-final.pdf>

#### **TO BE SUBMITTED POST-AWARD (mark all that apply):**

☐ **NRMRL's Quality System Specifications:**

- (1) a description of the organization's Quality System (QS) and information regarding how this QS is documented, communicated and implemented;
- (2) an organizational chart showing the position of the QA function; 07/14/08 A-2
- (3) delineation of the authority and responsibilities of the QA function;
- (4) the background and experience of the QA personnel who will be assigned to the project; and
- (5) the organization's general approach for accomplishing the QA specifications in the SOW.

- ☐ **Quality Management Plan:** prepared in accordance with R-2 - EPA Requirements for Quality Management Plans (EPA/240/B-01/002) March, 2001,  
<http://www.epa.gov/quality/qs-docs/r2-final.pdf>

- ☐ **Category I or II Quality Assurance Project Plan (QAPP):** prepared in accordance with R-5 - EPA Requirements for QA Project Plans (EPA/240/B-01/003) March, 2001  
<http://www.epa.gov/quality/qs-docs/r5-final.pdf>

- ☒ **Category III or IV QAPP:** prepared in accordance with applicable sections of the following NRMRL QAPP Requirements List(s) which is(are) included in this attachment:

## **X QAPP Requirements for Measurement Projects**

- ☐ **QAPP Requirements for Secondary Data Projects**
- ☐ **QAPP Requirements for Research Model Development and/or Application Projects**
- ☐ **QAPP Requirements for Software Development Projects**
- ☐ **QAPP Requirements for Method Development Projects**
- ☐ **QAPP Requirements for Design, Construction, and/or Operation of Environmental Technology Projects**

### **ADDITIONAL QA RESOURCES:**

EPA's Quality System Website: <http://www.epa.gov/quality/>

EPA's Requirements and Guidance Documents: [http://www.epa.gov/quality/qa\\_docs.html](http://www.epa.gov/quality/qa_docs.html)

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## **NRMRL QAPP REQUIREMENTS FOR MEASUREMENT PROJECTS**

### **GENERAL REQUIREMENTS:**

Include cover page, distribution list, approvals, and page numbers.

#### **0. COVER PAGE**

Include the Division/Branch, project title, revision number, EPA technical lead, QA category, organization responsible for QAPP preparation, and date.

#### **1. PROJECT DESCRIPTION AND OBJECTIVES**

- 1.1 Describe the process and/or environmental system to be evaluated.
- 1.2 State the purpose of the project and list specific project objective(s).

#### **2. ORGANIZATION AND RESPONSIBILITIES**

- 2.1 Identify all project personnel, including QA, and related responsibilities for each participating organization, as well as their relationship to other project participants.
- 2.2 Include a project schedule that includes key milestones.

#### **3. SCIENTIFIC APPROACH**

- 3.1 Describe the sampling and/or experimental design that will be used to generate the data needed to evaluate the projective objective(s). A description of the design should include the types and numbers of samples (including QC and reserve samples), the design of the sampling network, sample locations and frequencies, and the rationale for the design.
- 3.2 Identify the process measurements (e.g., flow rate, temperature) and specific target analyte(s) for each sample type.
- 3.3 Describe the general approach and the test conditions for each experimental phase.

#### **4. SAMPLING PROCEDURES**

- 4.1 Describe any known site-specific factors that may affect sampling procedures as well as all site preparation (e.g., sampling device installation, sampling port modifications, achievement of steady-state) needed prior to sampling.
- 4.2 Describe or reference each sampling procedure (including a list of equipment needed and the calibration of this equipment as appropriate) to be used. Include procedures for homogenizing, compositing, or splitting of samples, as applicable.
- 4.3 Provide a list of sample containers, sample quantities to be collected, and the sample amount required for each analysis, including QC sample analysis.
- 4.4 Specify sample preservation requirements (e.g., refrigeration, acidification, etc.) and holding times.
- 4.5 Describe the method for uniquely numbering each sample.
- 4.6 Describe procedures for packing and shipping samples, including procedures to avoid cross-contamination, and provisions for maintaining chain-of-custody (e.g., custody seals and records), as applicable.

## **5 MEASUREMENT PROCEDURES**

- 5.1 Describe in detail or reference each process measurement or analytical method to be used. If applicable, identify modifications to EPA-approved or similarly validated methods.
- 5.2 If not provided in Section 5.1 or the referenced method, include specific calibration procedures, including linearity checks and initial and continuing calibration checks.

## **6 QUALITY METRICS (QA/QC CHECKS)**

- 6.1 For each process measurement and analytical method, identify the required QC checks (e.g., blanks, control samples, duplicates, matrix spikes, surrogates), the frequencies for performing these checks, associated acceptance criteria, and corrective actions to be performed if acceptance criteria are not met.
- 6.2 Any additional project-specific QA objectives (e.g., completeness, mass balance) shall be presented, including acceptance criteria.

## **7 DATA ANALYSIS, INTERPRETATION, AND MANAGEMENT**

- 7.1 Identify the data reporting requirements, including data reduction procedures specific to the project and applicable calculations and equations.
- 7.2 Describe data validation procedures used to ensure the reporting of accurate project data.
- 7.3 Describe how the data will be summarized or analyzed (e.g., qualitative analysis, descriptive or inferential statistics) to meet the project objective(s).
  - 7.3.1- If descriptive statistics are proposed, state what tables, plots, and/or statistics (e.g., mean, median, standard error, minimum and maximum values) will be used to summarize the data.
  - 7.3.2- If an inferential method is proposed, indicate whether the method will be a hypothesis test, confidence interval, or confidence limit and describe how the method will be performed.
- 7.4 Describe data storage requirements for both hard copy and electronic data.

## **8 REPORTING**

- 8.1 List and describe the deliverables expected from each project participant responsible for field and/or analytical activities.
- 8.2 Specify the expected final product(s) that will be prepared for the project (e.g., journal article, final report).

## **9. REFERENCES**

Provide references either in the body of the text as footnotes or in a separate section.